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(54) Title: MARKING A VIDEO AND/OR AUDIO SIGNAL			
(57) Abstract			
<p>Method and arrangement for marking a video or audio signal to assign a classification to said signal, for example, to identify that the signal is authentic and may not be copied. The signal comprises at least two components (Y, UV) according to a predetermined standard (MPEG, PAL, NTSC). According to the invention, values are assigned to said components which in combination can normally not occur. For example, in black picture portions where Y, U and V are all zero, U and/or V are now wilfully made non-zero to constitute the watermark. Television receivers still display said black portion. The watermark is not lost when the signal is re-encoded and copied on a recordable disc. A player will not reproduce the copy because the watermark no longer corresponds with the "wobble key" of the new disc.</p>			

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Marking a video and/or audio signal.

FIELD OF THE INVENTION

The invention relates to a method and arrangement for marking a video or audio signal. The invention also relates to a method and arrangement for decoding said marked signal and a recording medium on which said marked signal is recorded.

5 BACKGROUND OF THE INVENTION

Known methods of marking a video signal are disclosed in WO 93/00769 and EP-A 0 518 616. The known methods modify a video signal such certain disturbances in the picture are introduced upon playback. It is also known to mark a video signal by adding data to the signal. One method is to accommodate data in the vertical blanking interval.

10 Another method is to blank a rectangular picture portion and replace said picture portion by a sequence of white and black spots that can be detected by a photodiode in front of the picture tube.

Nowadays, the subject of marking a signal is especially relevant with respect to the copy protection of digital video discs. It is desirable to provide the signal with a detectable code ("watermark") so as to identify the signal as being authentic and to render reproduction of the signal possible under specified conditions only. Video disc players are envisaged that are adapted to playback authentic video discs only. They reproduce recorded program material only if the video signal's watermark corresponds with a code ("wobble key") physically embedded in a given groove of the disc and not provided on a recordable disc.

The prior art methods mentioned above are not suitable to fulfil this task. They rely on the different sync behaviour of different types of domestic equipment, render it possible for a consumer to delete the watermark, or suffer from the disadvantage that the embedded mark affects the displayed signal.

OBJECT AND SUMMARY OF THE INVENTION

It is an object of the invention to mark a signal without introducing perceptible disturbances in the signal upon reproduction.

In accordance with the invention, the method of marking a video and/or 5 audio signal comprising at least two components according to a predetermined standard, is characterized by the step of assigning a value to said components which in combination cannot occur when the signal is generated according to said standard.

The invention exploits the property that particular combinations of component values never occur when real signals are generated. By wilful introduction of said 10 combinations without offending the relevant standard, the signal is classifiable in such a manner that the classification can be detected by special detector means.

Generally, the assignment of otherwise not occurring component values may cause visible artifacts on screen. This is prevented in an embodiment of the invention, wherein the step of assigning comprises modifying a first of said components in a signal 15 portion where a second of said components assumes a value for which the first of said component is redundant.

The first and second component may constitute the chrominance and luminance of a video signal, respectively. A preferred embodiment of the invention is characterized in that a predetermined non-zero chrominance value is assigned to signal 20 portions for which the luminance value is substantially zero. When encoded by a standard (PAL or NTSC) encoder, black signal portions have both zero luminance and zero chrominance. However, a zero luminance value in combination with a non-zero chrominance value is not prohibited by the relevant television standard. By introducing said non-zero chrominance values in black portions, the signal can be marked. The mark can easily be 25 detected by inspecting the luminance and chrominance values. Standard television equipment (receiver, recorder) processes the black signal portions as such.

As is not known in advance whether and where a video signal comprises black signal portions, it is envisaged to suppress one of the top or bottom video lines of a frame or field, and to apply the method to said video line. For the duration of said line, a 30 plurality of consecutive chrominance periods may together constitute a binary watermark code.

In the future, video programs will be stored on disc in a digital format. A method of watermarking digital signals, in particular MPEG2 encoded video signals, has been proposed in Applicant's European patent application 95202673.0, not published yet.

However, watermarking a digital signal is not the complete solution to the complicated problem of preventing digital video discs from being illegally copied. Any recorded digital signal is eventually decoded into an analog format so as to be displayed by a television receiver. After decoding, a digital watermark is lost. Nobody can prevent a consumer from 5 re-encoding the analog signal to a digital (MPEG2) signal and store it on a recordable disc. Now, the disc comprises a signal without watermark. Such a signal can not be distinguished from, *inter alia*, a home video.

The method according to the invention, when applied to the signal before being recorded on an authentic video disc, has the significant advantage that the watermark is 10 not lost. The specific combinations of zero luminance and non-zero chrominance values constituting the watermark are perfectly acceptable for an MPEG encoder (their presence merely affects the coding efficiency slightly). A video disc player, which is arranged to check the embedded watermark against the disc's wobble key, reproduces the signal if the authenticity of the signal is acknowledged. However, if a consumer re-encodes the 15 reproduced analog signal and records the encoded signal on a different recordable disc, the watermark is retained and no longer corresponds with the new disc's wobble key. Consequently, the video disc player will not reproduce the copy thus made.

BRIEF DESCRIPTION OF THE DRAWINGS

20 Figs. 1 and 2 show embodiments of arrangements for marking a signal in accordance with the invention.

Fig. 3 shows an arrangement for detecting a marked video and/or audio signal in accordance with the invention.

25 DESCRIPTION OF EMBODIMENTS

Fig. 1 shows one embodiment of an arrangement for marking a video and/or audio signal in accordance with the invention. In this Figure, reference numeral 1 denotes a video signal source which generates a conventional video signal in the form of a luminance component Y and two chrominance components U and V. The luminance 30 component Y is directly applied to a conventional video encoder 2. The chrominance components are applied to said encoder via respective modification stages 3 and 4 which, in the present embodiment, are adders. The video encoder 2 encodes signal component Y and modified chrominance components U' and V' into a composite signal for transmission in

accordance with a given standard such as PAL/NTSC/SECAM (analog) or JPEG/MPEG (digital).

The arrangement further comprises a black luminance detector 5 which produces a control signal $Y=0$ if the luminance value Y is substantially zero, i.e. if the corresponding picture area is black. The control signal $Y=0$ is applied to a mark generator 6 which, in response to the control signal, produces predetermined non-zero signal values u and v . The values u and v added to the chrominance components U and V by adders 3 and 4, respectively. For natural video source material, the signal components Y , U and V from video signal source 1 are all zero in black picture areas. The arrangement provides that the video encoder 2 encodes $Y'=0$, $U'=u\neq 0$ and $V'=v\neq 0$ in said areas. For non-black picture areas, the mark generator 6 is inactive and the video encoder encodes $Y'=Y$, $U'=U$ and $V'=V$ as in conventional arrangements.

The arrangement shown in Fig.1 relies on the presence of black signal portions in the picture. Fig.2 shows a further embodiment of an arrangement which forces a predetermined signal portion of the picture to be black. Fig.2 also illustrates that the modification stages 3 and 4 (which are adders in Fig.1) may be switches. The arrangement shown in Fig.2 operates as follows. During the predetermined signal portion (for example, the first or last active video line or portion thereof), the mark generator 6 controls a switch 8 to apply a luminance value $Y=0$ to the video encoder and, simultaneously, controls switches 3 and 4 to provide non-zero chrominance values $U=u$ and $V=v$. The predetermined signal portion is defined by a timing circuit 7 which receives a conventional synchronization signal S from the video source and produces a timing signal SP which defines the period of time when the mark generator 6 is to be active.

The signal generated by the arrangements described above can be reproduced by conventional apparatuses. Experiments have shown that the black portions will be displayed as such. However, apparatuses such as video disc players can be designed to reproduce a watermarked signal only under special conditions, for example, if the signal has been recorded on a video disc having a specific "wobble groove". A significant advantage of the invention is that the watermark is not lost when the signal is re-encoded and copied on a recordable disc not having such a wobble groove. Accordingly, the player will not reproduce the signal from such a recordable disc.

Fig.3 shows an arrangement for detecting a marked video and/or audio signal in accordance with the invention. The arrangement comprises a conventional analog (e.g. PAL/NTSC/SECAM) or digital (e.g. MPEG) decoder 11 which decodes the luminance

component Y and chrominance components U and V. The components are applied to respective zero detectors 12, 13 and 14, which generate a binary signal '1' if the relevant component is substantially zero. A combinational logic circuit 15 produces an output signal M if the luminance component Y is substantially zero and the chrominance components U
5 and V are not both substantially zero. Because such combinations of component values cannot occur in natural video scenes, the output signal M indicates that the video signal has been marked and may be reproduced under specified conditions only.

In summary, a method and arrangement for marking a video or audio signal is disclosed to assign a classification to said signal, for example, to identify that the
10 signal is authentic and may not be copied. The signal comprises at least two components (Y, UV) according to a predetermined standard (MPEG, PAL, NTSC). According to the invention, values are assigned to said components which in combination can normally not occur. For example, in black picture portions where Y, U and V are all zero, U and/or V
15 are now wilfully made non-zero to constitute the watermark. Television receivers still display said black portion. The watermark is not lost when the signal is re-encoded and copied on a recordable disc. A player will not reproduce the copy because the watermark no longer corresponds with the "wobble key" of the new disc.

Claims

1. A method of marking a video and/or audio signal comprising at least two components according to a predetermined standard, characterized by the step of assigning a value to said components which in combination cannot occur when the signal is generated according to said standard.
- 5 2. The method as claimed in claim 1, wherein the step of assigning comprises modifying a first of said components in a signal portion where a second of said components assumes a value for which the first of said component is redundant.
3. The method as claimed in claim 2, in which the first and second components constitute the chrominance and luminance of a video signal, respectively,
- 10 10. characterized in that a predetermined non-zero chrominance value is assigned to signal portions for which the luminance value is substantially zero.
4. A method of detecting a marked video signal comprising at least two components according to a predetermined encoding standard, characterized by the steps of determining whether the respective component values in combination may occur in a signal
- 15 15. according to said standard, and generating a mark output signal in response to said determining step.
5. The method as claimed in claim 4, wherein the step of determining comprises determining whether one of said components assumes a value for which the first of said component is redundant.
- 20 6. The method as claimed in claim 5, in which said components constitute the chrominance and luminance of a video signal, respectively, characterized by determining whether signal portions for which the luminance value is substantially zero are associated with a non-zero chrominance value.
7. An arrangement for marking a video and/or audio signal comprising at
- 25 25. least two components according to a predetermined standard, characterized by means for assigning a value to said components which in combination cannot occur when the signal is generated according to said standard.
8. The arrangement as claimed in claim 7, wherein the means for assigning a value to said components comprises means for modifying a first of said components in a

signal portion where a second of said components assumes a value for which the first of said component is redundant.

9. The arrangement as claimed in claim 8, in which the first and second components constitute the chrominance and luminance of a video signal, respectively, 5 characterized by means for assigning a predetermined non-zero chrominance value to signal portions for which the luminance value is substantially zero.

10. An arrangement for detecting a marked video signal comprising at least two components according to a predetermined encoding standard, characterized by means for determining whether the respective component values in combination may occur in a signal 10 according to said standard, and means for generating a mark output signal in response to said determining means.

11. The arrangement as claimed in claim 10, wherein the means for determining is adapted to determine whether one of said components assumes a value for which the first of said component is redundant.

15 12. The arrangement as claimed in claim 11, in which said components constitute the chrominance and luminance of a video signal, respectively, characterized by means for determining whether signal portions for which the luminance value is substantially zero are associated with a non-zero chrominance value.

20 13. A video or audio signal being marked to assign a classification to said signal, comprising at least two components according to a predetermined standard, characterized by having assigned a value to said components which in combination can not occur when the signal is encoded using an encoder according to said standard.

25 14. A signal as claimed in claim 13, wherein a first of said components is modified in a signal portion where a second of said components assumes a value for which the first of said component is redundant.

15. A signal as claimed in claim 14, in which the first and second components constitute the chrominance and luminance of a video signal, respectively, characterized in that a predetermined non-zero chrominance value is assigned to signal portions for which the luminance value is substantially zero.

30 16. A storage medium on which a signal as claimed in any of claims 13-15 is stored.

1/1

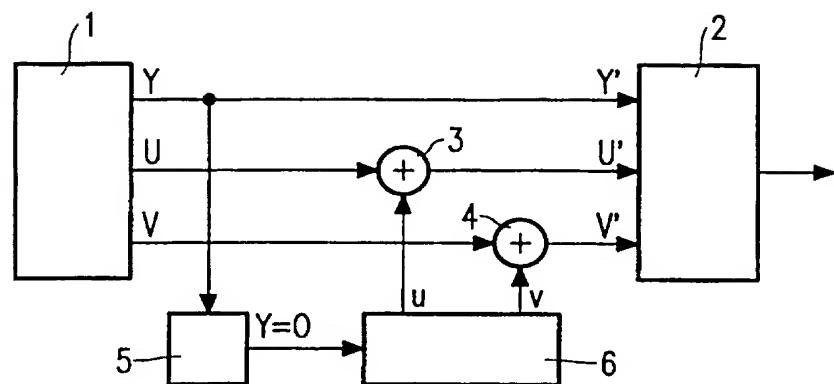


FIG. 1

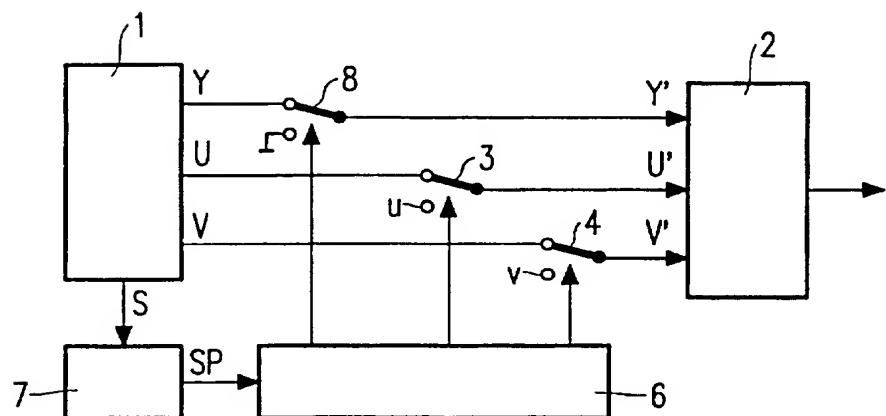


FIG. 2

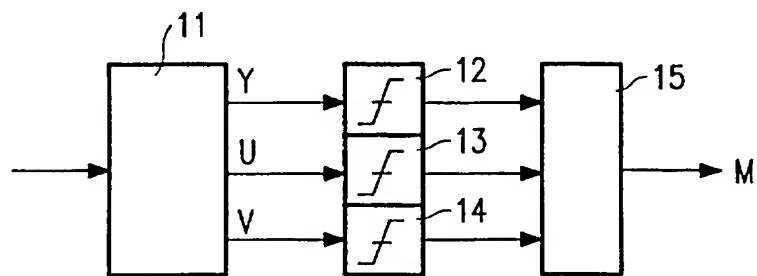


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB 96/01306

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04N 5/913

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04N, G11B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC; PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3928867 A (E.I. LYNCH), 23 December 1975 (23.12.75), column 3, line 34 - line 62 --	1-15
A	EP 0518616 A2 (SONY CORPORATION), 16 December 1992 (16.12.92), page 3, line 25 - line 28 --	1-15
P,A	EP 0704840 A2 (VICTOR COMPANY OF JAPAN, LTD.), 3 April 1996 (03.04.96), abstract --	1-15
A	EP 0581227 A2 (HITACHI, LTD.), 2 February 1994 (02.02.94), column 1, line 51 - column 2, line 33 --	1-15

 Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

18 April 1997

Date of mailing of the international search report

23 -04- 1997

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB 96/01306

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5418853 A (K. KANOTA ET AL.), 23 May 1995 (23.05.95), column 1, line 60 - column 2, line 41 -- -----	1-15

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB 96/01306

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.: 16 because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
No technical features characterising the invention claimed in claim 16 is given.
The claimed storage medium is not in any way described by said claim.
Therefore no meaningful search can be performed.
3. Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

The additional search fees were accompanied by the applicant's protest.

No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

04/03/97

International application No.

PCT/IB 96/01306

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US 3928867 A	23/12/75	CA 1048635 A		13/02/79
EP 0518616 A2	16/12/92	JP 4368085 A		21/12/92
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		BR 9302982 A		22/02/94
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